# *EXECUTIVE SUMMARY*

## *A. INTRODUCTION*

Maryland's Tributary Strategies identify management priorities for nutrient pollution control – called management "options" – which are designed to reduce 1985 nutrient pollutant loads from each of Maryland's major tributaries to the Chesapeake Bay by 40%. When the goal is reached in each tributary, it becomes the permanent limit for nutrient pollutant loads, i.e., the loads are to be "capped" at 60% of 1985 levels.

Maryland Growth Policy provides guidelines for planning and growth management, designed to concentrate growth, protect rural land resources, and encourage stewardship of the Bay. Maryland's 1997 Smart Growth initiative builds on existing policy, providing incentives to better focus growth and new development in planned areas, and financial assistance to preserve rural land.

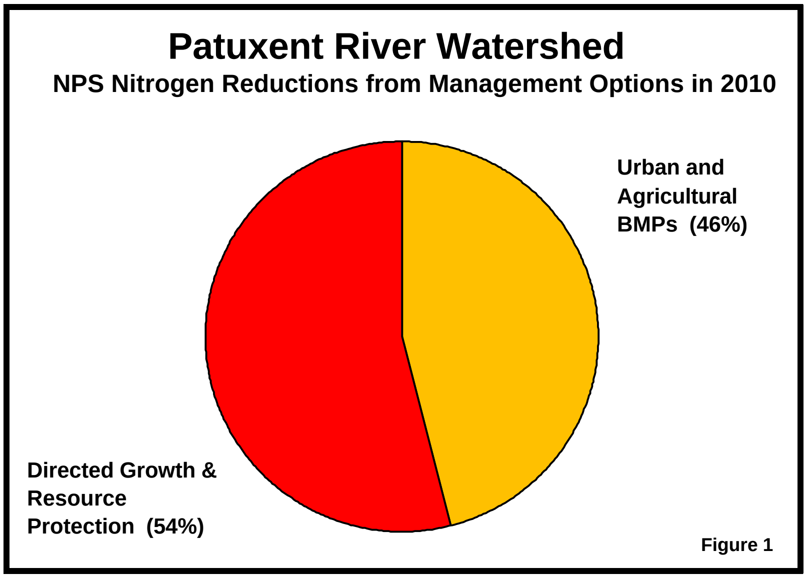

Figure 1

As with most nutrient management programs, the Tributary Strategies focus on point sources and urban and agricultural BMPs (Best Management Practices). However as Figure 1 shows, *Directed Growth* and *Resource Protection* options (Chapter 2) can be an equally important factor in reducing nutrients over time. This is especially true in fast-growing watersheds. The fact that *Directed Growth* and *Resource Protection* options are not addressed significantly in the Strategies leads to the primary purpose of this document: to supplement the Strategies with options that fill this void and also protect local watersheds.

This report shows how State Growth Policy and Smart Growth principles can be productively used to benefit the Tributary Strategies and maintain the nutrient "cap." It identifies growth management options; describes how the techniques affect land and water resources and nutrient pollutant loads; provides tributary and county-specific examples of the techniques and their projected effects; and provides guidelines for implementation that will protect local watersheds and make it possible to maintain the nutrient reduction "caps" or limits established for the Tributary Strategies.

## B. *WATERSHED IMPACTS AND THE ROLE OF GROWTH MANAGEMENT*

***OVERVIEW.*** Current growth patterns are having major impacts on Maryland's watersheds. The impacts include significant effects on local streams and watersheds, and on nutrient pollutant loads to the Chesapeake Bay. This report estimates these impacts in the Patuxent, Lower Western Shore, and Lower Potomac tributaries over a twenty-year period (1990 - 2010), and identifies Smart Growth guidelines that, if implemented, will reduce the impacts in the future.

Growth management plays numerous roles in watershed protection. By directing growth in appropriate ways, we can:

- Accommodate projected growth on substantially fewer acres of land;
- Conserve more resource and environmentally-sensitive land, such as forest, farmland, and riparian buffers along streams;
- Put more new households on sewer service and fewer on septic systems;
- Reduce nutrient pollution from new development and septic systems;
- Limit the impacts of growth to relatively few local watersheds in areas designated for growth; and
- Minimize impacts of growth on the Tributary Strategies.

To achieve these land and water resource objectives, local comprehensive plans and implementation programs (e.g., zoning) must increasingly plan for and manage growth by watershed. An effective watershed-based growth management strategy will:

- Establish local stream and conservation goals by sub-watershed;
- Direct growth by setting guidelines and appropriate limits on growth commensurate with watershed goals;
- Concentrate growth in watersheds that are not designated for high level water resource conservation; and
- Facilitate these desired results through the combined use of land use planning, growth management programs, resource conservation, and the use of conservation easements.

***GROWTH & THE TRIBUTARY STRATEGIES: DIRECT EFFECTS.*** To illustrate the importance of growth management for the Tributary Strategies, consider the following questions: How much will growth increase nutrient pollution in the future? Would well-directed growth make a difference? In the long term, what effect will growth management have on the pollution loads that reach the Bay, as compared to the effects of Best Management Practices (BMPs) for pollution control?

The answers: ten to twenty years from now, pollution loads from the Patuxent River Watershed, for example, will be much lower if growth is well-directed. How much lower? We estimate that in the year 2010, annual nitrogen pollution loads in the Patuxent Watershed will be more than 1.6 million pounds less per year if, in addition to BMPs, a specific set of *Directed Growth* and *Resource Protection* options are used to manage growth as part of the Patuxent Tributary

Strategy (see Chapters 2 and 3 for detailed explanation of options). This is almost 30% less nitrogen than would otherwise pollute the watershed in the year 2010.

What do we mean by *Directed Growth* and *Resource Protection* options? The following options are described in detail in Chapters 2 (a generic description of each) and 4 (for individual counties):

***Directed Growth and Resource Protection Options***
- ***Option # 1:*** Increase Development Potential in Growth Areas
- ***Option # 2:*** Transfer of Development Rights to Growth Areas
- ***Option # 3:*** Extend Sewer Service in Designated Growth Areas
- ***Option # 4:*** Protective Agricultural Zoning
- ***Option # 5:*** Purchase of Development Rights
- ***Option # 6:*** Rural Clustering
- ***Option # 7:*** Forest Conservation Programs
- ***Option # 8:*** Stream Buffer Protection Programs

How much would each type of management tool contribute to the potential 1.6 million pound reduction in year 2010 nitrogen loads?[1] As indicated in Figure 1, *Directed Growth* and associated *Resource Protection* options would account for 54% of the 1.6 million pound reduction – 892,080 fewer pounds of nitrogen per year. This is nearly equal to eliminating the entire nitrogen pollution load from all point sources in the Patuxent (see Chapter 3, Section C.2).

Clearly these management measures, which are implemented through the local planning, zoning, and the subdivision process, have major roles to play in limiting future pollution loads. In terms of long-term benefits, these growth management options can be at least as important as *Agricultural* and *Stormwater Management* BMPs, which together would account for about 46% of the year 2010 potential load reduction. In conjunction with other management tools, growth management will be one of the most important factors determining future pollution levels.

Many of these *Directed Growth* and *Resource Protection* options consist of techniques that local governments in Maryland have used to varying degrees for a long time. Their purpose has been to encourage orderly development patterns, create efficient public services, and provide safe communities, efficient transportation, good schools, and a variety of quality-of-life benefits. In addition, these time-tested planning and management techniques are also essential if we are to protect watersheds successfully and limit nutrient pollution in the long term.

Detailed information about individual growth management techniques, including many of the above options, is available through a series of reports from the Maryland Office of Planning. Each of these *Models and Guidelines* documents describes case studies ("Models") for the development and implementation of specific growth management measures by local agencies, and provides guidelines for their use. The documents in the *Models and Guidelines* series are referenced throughout this report.

***INDIRECT EFFECTS OF GROWTH ON NUTRIENT LOADS.*** In addition to direct impacts, growth has several indirect but significant effects on watersheds and nutrient loads. Specifically, growth and its management will strongly influence what can and cannot be accomplished through many other nutrient control measures, including stormwater management, agricultural BMPs, and waste water treatment.

- Development patterns play a major role in determining how much of the runoff from new growth can be effectively managed with stormwater management facilities (see Chapter 3, Section C.2 for illustration and further discussion).
- These patterns also play an important role in determining where and how much agricultural land exists ten to twenty years from now, and the types of agricultural operations that coexist with residential developments. The make-up of the agricultural sector will, in turn, strongly affect the importance of agricultural pollution control versus other pollution control practices in the future.
- Development patterns determine what percentage of new growth can be cost-efficiently served by central sewer (see *Benefits of Growth in Sewered Areas* under Guideline # 2 in Section B.1, Chapter 1, and *Point Sources* in Section C.2 of Chapter 3). The amount of development served by central sewer versus septic systems in turn determines how much can be accomplished through waste water treatment plant technology for nutrient control, versus on-site disposal techniques.

***IMPACTS ON LOCAL STREAMS AND WATERSHEDS.*** Concentrating growth has tremendous potential to benefit local streams. Chapters 3 and 4 use a series of maps to illustrate this point for both the Patuxent River Watershed (Chapter 3) and selected counties (Chapter 4). These maps use the amount of "impervious cover" in small subwatersheds as an indicator to assess the potential impacts of development on stream quality.[2]

"Impervious cover" refers to paved surfaces (like parking lots and sidewalks), buildings, and generally any land cover type impervious to rainfall. Impervious cover, as well as other cover types associated with development, such as lawns, affect the fate of rainfall. Basically, these cover types reduce the amount of rainfall that infiltrates the soil profile and flows to streams as groundwater. The amount and velocity of surface runoff and the amount of nutrient pollutants carried by runoff increase as resource lands are developed. Consequently, streams "dry up" to varying degrees during dry periods; stream channels erode and become unstable; habitat for aquatic living resources deteriorates; and water quality degrades.

The maps in this report use the relationship between impervious cover and stream quality to assess the potential impacts of development in each subwatershed[3] over time. As the amount of impervious cover increases, so do the impacts.

The map shown on page ix highlights the difference in the potential impacts of development on stream quality in the year 2010 under two scenarios for growth, one called *Current Programs* and another called *Directed Growth*. The scenarios are described in Chapter 2. In summary,

**Map goes here**

Directed Growth includes a variety of smart growth options beyond those assumed under *Current Programs*; both scenarios accommodate approximately the same amount of growth in households, population, and employment.

The map illustrates that *Directed Growth* could significantly reduce the impacts of future development as projected under *Current Programs* in many of the subwatershed areas shown. Specifically,

- Subwatersheds labeled "Improved" on the map (solid black shading) could have significantly better stream quality in the year 2010 under *Directed Growth*. Streams in these subwatersheds drain about 130,000 acres, almost one quarter of the watershed.
- Subwatersheds with "Unchanged" conditions (lighter grey) would degrade equally by the year 2010 under both scenarios. These watersheds total about 118,000 acres.
- Under *Directed Growth*, additional degradation -- beyond that predicted for *Current Programs* -- would occur in only 2 subwatersheds, totaling 7,900 acres of drainage area (darker grey areas, in northern Saint Mary's County).
- Stream impacts from development in the remaining (white shaded) subwatershed areas would not increase substantially from 1990 under either scenario (the amount of new development would not be very large relative to the amount already present in 1990).

## *C. MANAGEMENT IMPLICATIONS*

The bottom line is that growth, and how it takes place, will dictate many of the possibilities for watershed protection in the future. Figuratively speaking, growth and its management will determine the playing field for watershed restoration efforts. Which aquatic resources will it be possible to preserve? How much will it be possible to accomplish through BMPs and point source technology? The findings reported here show that, for purposes of the Tributary Strategies, additional growth management measures are essential if we are to reach and maintain the nutrient loading caps of the Strategies, and achieve the associated living resource goals. To effectively manage growth and minimize pollutant loads, these measures must be implemented before and while growth occurs, not afterwards.

***GENERAL CONCLUSION:*** As illustrated in some detail in Chapter 3, *Directed Growth* options will concentrate growth considerably beyond what is occurring under *Current Programs*. These options must become an explicit part of the Tributary Strategies if they are to be successful in the long term. Specific options that could be considered are illustrated for individual counties in Chapter 4. Generally, it will be essential to accomplish the following:

- Concentrate growth at higher densities;
- Maximize new growth in sewered areas;
- Focus new development in a limited number of designated growth areas;

- Minimize development in subwatersheds designated for agricultural, natural, and aquatic resource preservation; and
- Permanently protect extensive acreage of resource lands and environmentally-sensitive areas.

***IMPLICATIONS FOR THE THREE TRIBUTARIES.*** The importance to the Tributary Strategies of various management options over time depends on existing land use / land cover patterns, projected growth, and which nutrient (nitrogen or phosphorus) we consider. This is illustrated by comparing the contributions of management measures to the total nutrient load reduction that could be achieved by 2010, under "best" and "worst" case management scenarios in each of the three tributaries. The following is a sampling of results from that comparison, presented in more detail in Chapter 3.

| | | ——— Percentage of Total 2010 Load Reduction from: | | | ——— |
|---|---|---|---|---|---|
| ***Tributary*** | ***Nutrient*** | ***Directed Growth*** | ***Ag BMPs*** | ***Res. Cons.*** | ***stormwater BMPs.*** |
| ***Patuxent*** | Nitrogen | 26% | 38% | 28% | 8% |
| ***L. W. Shore*** | Nitrogen | 31 | 25 | 36 | 8 |
| ***L. W. Shore*** | Phos'us | 17 | 41 | 28 | 14 |
| ***Lower Potomac*** | Phos'us | 13 | 60 | 21 | 6 |

The implications of these findings can be summarized as follows:

- Where projected growth is high relative to watershed size (in the Patuxent and Lower Western Shore -- see Section B in Chapter 3), growth management options, which include those labeled *Directed Growth* and *Resource Conservation*, collectively account for the majority of the potential reduction in nonpoint source nitrogen loads. For phosphorus load reductions (generally more dependent upon BMP implementation), the *Directed Growth* and *Resource Conservation* options account for almost half of the potential phosphorus reduction (45%) in the Lower Western Shore.
- Where projected growth is significantly less in relation to watershed size (i.e., in the Lower Potomac), *Directed Growth* and *Resource Conservation* options are still important and account for about 34% of the total phosphorus reduction.

It seems reasonable that *Directed Growth* and *Resource Conservation* options will have similar importance in other tributaries, depending on their size, projected growth, current programs, and the severity of existing nutrient pollution sources. A Statewide analysis is underway and scheduled for completion by autumn of 1998.

## D. ORGANIZATION OF THE REPORT

This report uses findings from several pilot projects in Maryland to demonstrate the important relationship between two priority objectives for the State: Smart Growth and the Tributary Strategies. The report is organized as follows.

**Chapter 1.** Background information and a summary of general guidelines for watershed-based management of growth are presented. Specifically,

- ***General guidelines*** for growth management options are summarized in Section B.1. These guidelines describe a few of the most important relationships between growth, growth management, and the resulting impacts and benefits for land and water resources. The general guidelines are a point of departure for more geographic-specific planning at the tributary or local levels.
- ***Guidelines for specific growth management options*** are summarized in Section B.2 of Chapter 1. The discussion indicates the kinds of effects that can be expected from the use of specific options.

**Chapter 2.** The methods used to evaluate management alternatives and identify effective management options in the pilot projects are described in Chapter 2.

- Section A defines "Growth management options" for purposes of this report.
- Section B describes the watershed planning system used to estimate the effects of growth and management options on land resources, pollution loads, and local streams and watersheds.
- Section C defines the alternative "management scenarios" examined through the projects. The scenarios are the basis for the findings and guidelines presented in Chapters 3 and 4.

**Chapter 3.** Findings and guidelines for three tributaries -- the Patuxent, Lower Potomac, and Lower Western Shore -- are reported in Chapter 3.

- Section A presents an overview of the Chapter.
- In Section B, the three tributaries are compared in terms of land use, projected development pressure, and capacity for growth in areas planned for sewer service and higher residential densities.
- Section C reports in some detail the effects of growth management options on land resources, pollution loads, and local watersheds in the Patuxent River Watershed.
- Sections D and E present selected findings for the Lower Western Shore and Lower Potomac watersheds, respectively.
- Section F uses the information from the other sections to illustrate the range of effects growth management options can have under the varying conditions found in the three tributaries, and summarizes the management implications of the findings for the Tributary Strategies and watershed protection.

**Chapter 4.** Chapter 4 highlights findings in three of the counties contributing to the pilot projects, selected to illustrate a range of options and their effects. Growth management options at the tributary scale necessarily cover a range of techniques, simply because management measures differ among counties. All of the counties in a tributary may, for example, have designated growth areas and sensitive area protection programs. However, significant details of these programs often differ among counties; so do their effects on growth, consumption of resource lands, and future pollution loads. Chapter 4 focuses on individual growth management options unique to individual counties, where their effects are most clearly seen.

## ENDNOTES

1. The load reduction is the difference between estimated 2010 nitrogen loads under a *Directed Growth* scenario and a *Base Zoning* scenario, explained more fully in Chapter 2. Different management measures are assumed in the two scenarios.

2. Subwatersheds used for these projects correspond to State-designated watersheds called subcatchments. Subcatchments are generally watersheds of $3^{rd}$ order or larger streams; however, along the estuary and in a few other instances, subcatchments comprise watersheds of smaller ($1^{st}$ or $2^{nd}$ order) streams.

Subcatchments are sometimes divided by county boundaries; counties manage growth and development differently. Consequently, the geographic units used to model new development and land use change in the analysis are defined by a combination of subcatchment and county boundaries. These are the subwatersheds depicted on the maps in this report. There are 138 of these small areas, termed county/subcatchments, in the Patuxent Watershed, 32 in the Lower Western Shore Watershed, and 84 in the Lower Potomac Watershed, for a total of 254 in the three tributaries examined. In the 7 counties for which analysis was completed, there are a total of 365, some of which are in the Middle Potomac and Patapsco / Back River tributaries.

3. Classifications are adapted from percent impervious cover thresholds associated with stream impacts ( T. Schueler, 1994, *Site Planning for Stream Protection, Chapter 3: Watershed Based Zoning*. Center for Watershed Protection).